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TASTES AND ODORS[1]

Mr. H. M. **Ely**:[2] Danville's water supply is impounded by two dams on the North Fork of the Vermilion River. A dam at the pumping station forms the first impounding reservoir of about seventy-five million gallons capacity, in service since 1903. Another impounding reservoir is formed by a second dam located four miles up stream from the first, which has a capacity of approximately four hundred fifty million gallons. This reservoir has been in use since January, 1915.

There had been growth in the lower reservoir for some years, but never of such a character or of sufficient amount to cause any trouble. In September, 1916, a microscopical survey of both reservoirs was made by Greenfield and Mickle, of the State Water Survey. The examination showed moderate algae growth, with the microscopic flora of the reservoir rather uniform. The micro-organisms found at that time were protozoan forms, rotifers, chlorophyceae; crustaceans rather numerous; protococcus most numerous; euglena in small numbers. A second microscopical survey was made by the same persons in July, 1917, which showed the microscopic flora not materially different from that of the first survey. The organisms present at that time were diatoms, protocola, rotifers and crustaceans, in addition to the algae forms, with no euglena. Both of the surveys showed the water of the reservoirs to be in good condition. It was also stated that no serious trouble from odor qr any difficulty in filter operation might be anticipated from the number of organisms present. It might be possible during extreme periods of warm weather and drought and the decay of vegetables might give rise to extreme growth of micro-organisms to cause annoyance. This proved to be true later on.

In the summer of 1919, Danville experienced a severe drought, covering a period from July 1 to the latter part of October. The rainfall had been deficient not only during this period, but during all the preceding months of the year. The lower reservoir was drawn down five feet, but was maintained at that level by allowing water to flow from the upper reservoir through a gate in the dam down stream into the lower reservoir. In doing this the upper reservoir was drawn down nine feet.

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[1] Topical discussion before the Illinois Section Meeting, March 30, 1922.

[2] Superintendent, Water Company, Danville, Ill.

On August 18 a taste and odor suddenly appeared in the water, which was obnoxious and rendered the water unpalatable, although, from the bacterial standpoint, it was safe for drinking purposes. Inspection of the reservoirs on August 20 and 21 showed patches of green scum and in places there were noted streaks of brick-red scum. This was not continuous over the water, but in patches. Its effect seemed to be distributed, however, throughout the reservoir, for the water, even where no scum existed on the surface, had a reddish cast. The amount of scum was not nearly so great in area as had been found in previous years, but was composed of a different form of micro-organisms. On August 26, Miss Jewell, of the State Water Survey, made a microscopical examination of the water in both reservoirs. The organisms found at this time were euglena, peridinium, anabaena, arcella, diatoms and rotifers, showing euglena to be the predominant form. The first three organisms are known to impart a fishy and oily taste to the water and the fourth a grassy or moldy taste.

Samples of the filtered water were sent to the State Water Survey on August 11 and 21, September 8 and 30 and October 6. The analyses of all of these showed the water to conform to the United States Treasury Department's Standard for purity of water used on interstate carriers, although the taste and odor were still evident.

On August 27 the lower reservoir was treated with copper sulphate, by dragging a bag from the stern of a boat. One and a half pounds or 0.2 part per million were used, as nearly as could be determined. This treatment had no effect upon the taste and odor of the water. On September 30, Dr. Edward Bartow, chief of the State Water Survey, and R. E. Greenfield made a further investigation. Upon their recommendation the upper reservoir was treated with copper sulphate, as it passed through the gate channel in the dam, at the rate of five pounds per million gallons, and also the lower reservoir again treated, but at a rate of eight pounds per million gallons. The application of the copper sulphate at the upper reservoir was made from a barrel provided with a faucet set over the gate channel and calibrated to give the required rate of flow of the copper sulphate solution with which the barrel was charged. This treatment was started on October 2 and was continued until October 9. About October 7 the taste and odor began to disappear and in a few days the character of the water was back to normal. There had not been sufficient rainfall to affect the river until about October 5, at which time and, also upon October 9 a heavy rainfall occurred, which may have been a factor in bringing about the improvement.

In the year 1920 an unusually severe drought occurred, covering a period from June to December. The lower reservoir was drawn down eleven feet and the upper reservoir sixteen feet. During this period there was a slight odor at times, but not enough to cause annoyance. No microscopical examinations were made during this period.

In the year 1921 the water company bought a microscope and began making frequent examinations in order to anticipate any possible trouble, by gaining knowledge of the condition of the reservoir and by beginning the copper sulphate treatment early enough. The organisms found during that summer were volvox, protococcus, pediastrium and scendesmus, all of the chlorophycea group; peridinium of the protozoan group and anabaena of the cyanophyceae group. Of the above named organisms, volvox and peridinium impart the fishy taste; anabaena the moldy taste; the other organisms are not troublesome. We were able to eliminate the fishy odors, but not altogether the moldy odors, by copper sulphate treatment and aeration. The moldy odor lasted only several weeks, and while rather disagreeable, was not nearly so serious as the odor in the year 1919.

Remedies for taste and odors. The copper sulphate treatment has been discussed and we will now consider aeration.

In 1920 it became necessary to make improvements to our filtration plant. These improvements consisted of an additional filter, a large sedimentation basin, together with mixing chamber and an aerator. These were designed by Mead and Seastone, Consulting Engineers, Madison, Wis. These improvements were completed and put in service in August, 1921. The aerator was built for the purpose of attempting to remove the taste and odor from the water. The aerator consists of a group of fountains set in a concrete basin. The fountains are vertical iron pipes near the top of which are placed perforated boiler plate conical hoods. The water flowing from the top of these pipes falls down over the hoods through the perforations in them, so as to break up the water and expose it to the air.

As the aerator was not completed until August, 1921, there has not yet been sufficient opportunity to make a thorough test of its efficiency in removal of taste and odor. However, as mentioned before, in the year 1921 we did have micro-organisms in the raw water, causing a fishy and moldy taste. The fishy taste was removed by aeration, but as stated we were not altogether entirely able to eliminate the moldy taste from the anabaena organisms. We trust that all these objectionable tastes and odors may be removed with a more thorough copper sulphate treatment than was given in the summer of 1921, together with aeration. Our experience along these lines has not yet been sufficiently broad to state just what may be accomplished by copper sulphate and aeration, but we believe we will be able to improve materially the character of the water when such tastes and odors occur.

In November, 1921, some odor in the river water was removed by aeration. At that time no microscopical examinations were made. We do not know, therefore, what organisms caused the odor at that time.

Up to date, in the year 1922, it has not been necessary to use the aerator.

Mr. H. F. FERGUSON:[3] Mt. Vernon had the same experience with tastes and odors in the public water supply in the late fall and early winter of 1919–1920 as at Danville in 1920–1921. The tastes and odors occurred during the cold weather. In December the water in the lower reservoir became low and they increased the supply by bringing water from the upper reservoir. These conditions are somewhat similar to those at Danville, in that they have lower and upper reservoirs and let the water flow down the stream from the upper reservoir and then pump from the stream into the lower reservoir.

We were not sure whether the development of the organisms in the water, resulting in the tastes and odors, were due to the inflow from swamp land surrounding the lower reservoir, following a thaw, or whether the organisms originated in the upper reservoir of creek water. We were not advised of the situation until too late for satisfactory microscopic examinations. Analyses of samples made towards the end, when the taste began to disappear, showed euglena to be present. That was our first experience at Mt. Vernon at that season of the year. We had it frequently in the late summer and early fall.

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[3] Chief Engineer, State Department of Health, Springfield, Ill.

Regarding the case at Danville, we went there in November, 1919, at the request of the local health officer He thought the water was dangerous because of the taste and odor. Taste and odor do not necessarily represent dangerous water, although their physiological effect is sometimes bad on people and may tend to lower their general physical or mental condition. As an example of the indirect effect on health of the presence of tastes and odors in a public supply, I might cite one instance at Danville The city water was safe, although it had taste and odor. School authorities ordered the bubbling fountain in one school closed and installed a barrel and water was carried from a shallow dug well located only about 15 feet from a privy and decidedly subject to contamination from it. This was a case where all the taste and odor did not endanger the health, but the supply they resorted to did endanger their health. Our department feels that, although the tastes and odors in waters are not dangerous to health, it is important to try to get rid of them, if possible, because when they exist people resort to unsafe supplies in preference to drinking those having tastes and odors.

Mr. E. M. GREENFIELD:[4] I should like to say a few words about the work carried on by the State Water Survey in 1916 and 1917. Mr. Mickle did most of the work. It was carried on principally as a research problem, which is within the province of the State Water Survey, with the aim of finding out whether the Illinois reservoirs were subject to growths of odor-producing organisms. The work was discontinued in a short time on account of war time conditions, but as far as we went we practically proved that there were odor-producing organisms in all Illinois reservoirs. These odors were not present at all times because conditions were not the same at all times, but when certain conditions prevail we may expect the development of odors in any reservoir. That was true of the Danville reservoir and of all the reservoirs we visited. Just a word in reference to Mt. Vernon. The engineering firm of Alvord & Burdick asked Dr. Bartow to survey that reservoir in 1919, at the same time Mr. Ferguson speaks of. At that time we found synura in the lower reservoir in large quantities. The odor was such as always has been described as synura. There was no synura in the upper reservoir or in Casey Fork, so that it would seem that if they had made arrangements to use the upper reservoir during that period they would not have had that trouble. Most people think that water becomes stagnant in the winter and synura is especially prone to come in spring when the ice is just breaking up. Mt. Vernon was running true to form, therefore, in the synura growth.

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[4] Illinois State Water Survey, Urbana, Ill.

Many water works men think they are free from algae due to a lack of seed in the reservoir. However, they are there. It is just simply a matter of the proper seed bed. I might say that there is no method that has ever produced satisfactory results in all cases.

I might also say that, when a state department is called in to visit you in case of trouble like this and any treatment is recommended, if it does not work, we should like to know it. Next time we would not recommend that treatment. If it does work successfully, we should like to know that. If you consult the literature on the odors and tastes problem you will find it meager. There is no routine treatment for water that has no odor that can be expected to work in all cases. It is for the most part a matter of research. Aeration is a possibility. It works sometimes. I think it worked at Danville, but it will not in all cases. I will say that the Southern Illinois Public Service Co. has always followed up with information and this criticism is not directed at them.

Mr. Wm. Molis:[5] In Davenport, where river water is used trouble was had last year when taste and odor came on. They emptied the reservoir and cleaned it out. They also increased the chlorine to 18 pounds per million gallons, but that did no good. They then emptied the reservoir again. Then they decided to treat the water with copper sulphate and that was the only thing that cured the water. When the river was muddy they did not have trouble, but as soon as the river cleared up the trouble began. Algae will not grow in muddy water, but grows rapidly in clear water.

We had the same experience at Muscatine. We have driven wells and had been operating for 20 years without any experience from tastes and odors, but last summer we got taste and odor in our water. I immediately emptied the reservoir, and cleaned it out and increased the chlorine dose. I had never used the chlorine apparatus before. We had it installed for emergency purposes.

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[5] Superintendent, Water Works, Muscatine, Iowa.

A MEMBER: Your reservoir is not in a river bed?

Mr. WM. MOLIS:[5] No it is up on a high elevation. We get just as much algae in winter as we do in summer. The temperature of the water is about 50 degrees. I did not try the copper sulphate treatment for the reason that we found it was against public favor.

A MEMBER: Even Chicago with its reservoir has trouble with odors. About two years ago the lake turned over in a remarkable way. At times the odor was so bad from the lake that even in a theater you might suspect a dog under the seat. At times, very frequently in fact, there seems to be a chlorine taste. It may be due to wastes from the Standard Oil Co. at Whiting, Ind. In my home, which is about 35 miles distant from that point, we get a taste which I think comes from a gas plant. It may be the action of the chlorine on some of the refuse matter.